Waterproofing Works for Structures using Cementitious Materials

Fig. 5.1: Standard practices for waterproofing

Importance of Waterproofing in a Building

To prevent water seepage and rainwater penetrating in a building, treatment is given to check water entry in the wall, bathroom and roof. This treatment is known as waterproofing. Waterproofing increases the life of the structure.

During the construction of a structure or building, special care is taken to make it waterproof. Waterproofing is done in basements, podiums, damp areas, water-bodies, terraces, roofs and external walls. When a building shows signs of seepage in any of its areas, then waterproofing treatment is done. Waterproofing can be done during as well as after the construction.

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Basic Terminology used in Waterproofing

Waterproofing

This is the process of making an object and structure in such a manner that no water seeps in. Water-resistant under specified conditions means that it remains relatively unaffected by water. This process can be used in wet and underwater conditions of specified depths.

Bitumen Mastic

This is a multi-purpose trowel grade bituminous material for waterproofing, stopping, bedding, pointing and sealing. For waterproofing of roofs, bitumen mastic is used with material code number IS:3037-1965.

Bonding Material

Any material that connects two substrates on application in layers is a bonding material. Roof surface requires a mixture, which is selected for local conditions of prevailing gradient and temperature, and it consists of blown bitumen conforming to the code number IS: 702-1961 or residual bitumen conforming to the code number IS 73-1961. When tested in accordance with IS: 1203-1958, the blown type bitumen penetration should be limited to 45.

Fig. 5.2: Execution process of waterproofing works

Reinforcement

Bitumen coated plain expanded metal lathing used for laying bitumen mastic to sloping or vertical surfaces.

Underlay or Isolating Membrane

It is a layer of bitumen felt (sheet) conforming to IS: 1322-1965.

Vapour Barrier

The function of a vapour barrier is to retard the migration of water.

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A vapour barrier can be as simple as a heavy gauge plastic sheet or an aluminium foil bonded to insulation sheets.

It consists of hessian based type 3 felt conforming to IS: 1322-1965 and with minimum overlaps of 100 and 75 mm at the end and the sides of strips of felt. It is also used as an isolating layer between the roof deck and insulating materials, which protect the insulation against the absorption and the effects of moisture from below.

Tools and Equipment used for Waterproofing

- Brooms
- Brushes
- Buckets
- Caulking guns
- Chisels, including cold chisels
- Cutting blades
- Dumpy, laser and water levels
- Electric drills and screwdrivers
- Electric hammers
- Extension leads
- Fusion rollers
- Gas burners and torches
- Hammers
- Hoses
- Measuring tapes and rules
- Mixers and mixing apparatus
- Moisture meters
- Nylon rollers
- Wood floats
- Vacuum cleaners
- Plant, including:
  - Excavating equipment
  - High pressure water equipment
  - Pumps
  - Heat welders
  - Hot air welders
  - Impact drills
  - Pressure injection equipment
  - Compressors
  - Cartridge applications
  - Vacuum pumps
- Pressure rollers
- Scissors
- Seam probes
- Solvent applicators
- Spirit levels
- Straight edges
- Trowels

Basic Levelling Tools used for Masonry

In construction work, level is the second most important tool after trowel. A good level is lightweight and absolutely straight and for getting better levels,

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spirit level tool is used. The purpose of the level is to keep the work you are doing plumb (even high and low, or vertically and even straight across, or horizontally). The following are the important tools that are used for levelling.

Spirit level

A good level has usually six vials, first two in the center and two at each end. In order to be straight or levelled, the bubble must line up between the two red or black lines. You might want to get a level that is at least 36" long while laying more than one block at a time.

Fig.5.3: Spirit Level

Plumb bob

A plumb bob or plummet, is a weight, having a pointed tip on the bottom, which is suspended from a string and used as a vertical reference line, or plumb-line. It is essentially the vertical equivalent of a 'water level'.

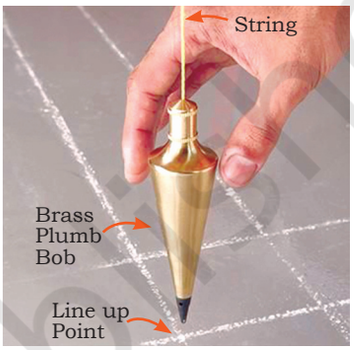

Fig. 5.4: Plumb Bob

Water level

A water level is a device used for matching elevations of locations that are too far apart for a spirit level to span. The simplest water level is a section of clear tubing, partially filled with water.

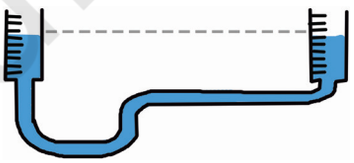

Fig. 5.5: Water Level

Mason line

It is used to create straight lines and a level surface and this line will let you build walls without bulges or hollows. A mason's line is placed very close to the block that is being laid, but there is enough room to still permit you to swipe off the excess mortar without disturbing the line.

Fig. 5.6: Mason line

Material Required for Waterproofing

- Cement
- Sand
- Metal

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- Brick bats
- Waterproofing powder chemical
- Geruor Red colour
- Shahabad tiles
- G. I. Sockets

Fig. 5.7: Bitumen

Waterproofing chemicals

Bitumen

Limestone or sand is mixed with a filler component. Polymers are added to the bitumen such as APP (Atactic Polypropylene), a plastic additive that gives rigidity and tear resistance, or SBS (Styrene Butadiene Styrene), a rubber additive which gives more elastic benefits.

Base products

Polyester, fiber glass, rag fiber (hessian) and paper are used as base products in waterproofing chemicals. These products are bought in the form of roll format and are pulled through the bitumen mixes on huge rollers. The base product becomes saturated in huge tanks by the tar like bitumen substance, thus creating a roll of waterproof material.

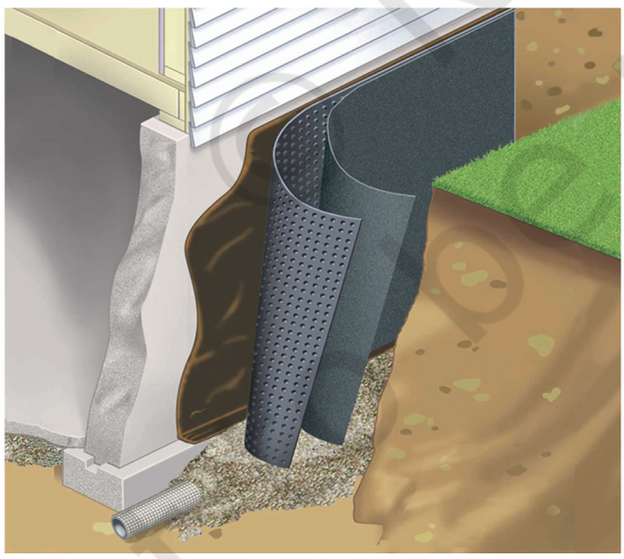

Fig. 5.8: Waterproofing membranes

Waterproofing membranes

- In this waterproofing membrane system, it includes both negative and positive side waterproofing works.
- The positive side waterproofing systems are applied to the face of the element that is directly exposed to moisture, i.e. the exterior side.
- The negative side waterproofing systems are

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applied to the surface of the element opposite to the surface which is exposed to moisture, i.e. the interior side. Positive systems are available in different types of materials and forms but negative systems are limited to cementitious systems.

Fig. 5.9: Spraying waterproofing material

Waterproofing compounds

Different types of waterproofing compounds used for waterproofing works.

Fig. 5.10: Waterproofing compounds

Wonder-seal

It is an integral waterproofing compound used for plaster and concrete. It makes the concrete dense and cohesive and can be used with all types of cement. It is free from any sulphates and chlorides. Wonder-seal cement waterproofing compound is ideal for buildings, industrial constructions, reservoirs, sewers, swimming pools, cellars, etc. In these areas, impermeability is a must. It contains an active water repellent admixture which fills the pores in cement concrete or mortar and also overcomes the capillary absorption of moisture to prevent the passage of water. Proper ramming or the use of vibrator is strongly recommended for best results.

Crystal Sealer

It is a cement based waterproofing compound that chemically reacts with moist cement based substrates. Crystal sealer forms insoluble crystals in the capillary tracts of the substrate permanently waterproofing the surface yet still allowing the surface to breathe.

- Various range of products for waterproofing and repairs are available for use in construction. This range includes Waterproofing Compounds, Repair Products, Tile Fixing Products, Sealants

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and Putties, Concrete Admixtures, Flooring Products and Grouts.

Water Based Exterior Wall Emulsion Paint Series

Nowadays for new or old exterior surface of brickworks, plaster and concrete Water based exterior wall emulsion paint series are available in the market. Important features of these paints are dust roof, alkali fungus resistant, weathering resistant, strong adhesion, and long service life. These paints are characterised by model number like:

VB1200- Project Use Exterior Wall Emulsion Paint
1900-Superfine Exterior Wall Emulsion Paint
2900-Superfine Exterior Wall Emulsion Paint
5900-Superfine Exterior Wall Emulsion Paint
VH1001-High Glossy Exterior Wall Emulsion Paint
V0000A-Elastic Exterior Wall Paint

Fig. 5.11: Cementitious waterproofing

Different Types of Waterproofing Methods

Cementitious waterproofing

It is the easiest method of waterproofing used in construction. The materials for cementitious waterproofing are easily available from the suppliers of masonry products, and they're easy to mix and apply.

This method is often used in the internal wet areas such as toilets. This method is usually a rigid or semi-flexible type waterproofing, but since it is used in internal areas such as toilets, it is not exposed to sunlight and weathering. Thus cementitious waterproofing does not go through contract and expansion process.

Application of cementitious waterproofing

Cementitious waterproofing is used in the following type of structures:

- Water treatment plants
- Sewage treatment plants
- Bridges

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- Dams
- Railway and Subway system
- Marine cargo ports and Docks
- River locks or Channels and Concrete dykes
- Parking structures and lots
- Tunnels

Liquid waterproofing membrane method

Fig. 5.12: Liquid waterproofing

Liquid membrane is a thin coating which usually consists of a primer coat and two coats of top coats which are applied by spray, roller, or trowel. It offers more flexibility than the cementitious type of waterproofing. The liquid cures into a rubbery coating on the wall. The elongation properties of the coating can reach as high as 280%. The durability of the waterproofing coating depends on the type of polymer that the manufacturer uses for making the liquid waterproofing.

Liquid waterproofing membrane can be spray-applied liquid membrane composed of polymer-modified asphalt. Polyurethane liquid membranes in separate grades for trowel, roller, or spray are also available from various manufacturers.

Bituminous coating waterproofing method

Fig.5.13: Bituminous Coating

Bituminous coating is a type of coating used for waterproofing and flexible protective coating in accordance with its formulation and polymerisation grade. Its flexibility and protection against water can be influenced by the polymer grade as well as the reinforcement of fiber.

Bituminous coating is also called asphalt coating. The most common applications of bituminous coating include areas that are beneath screed wet. It is an excellent protective coating

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and waterproofing agent, especially on surfaces such as concrete foundations. Bituminous coating is made of bitumen based materials and it is not suitable to be exposed to sunlight. It becomes very brittle and fragile when long exposed to the sunlight unless it is modified with more flexible material such as polyurethane or acrylic based polymers. The flexibility of the finished products depends on the solid content of the polymer added to the bitumen.

Bituminous membrane waterproofing method

Bituminous membrane waterproofing is a popular method used for low-sloped roofs due to their proven performance. Types of bituminous waterproofing membranes are torch-on membrane and self-adhesive membrane.

Self-adhesive compounds comprise asphalt, polymers and filler; additionally, certain resins and oils may be added to improve adhesion characteristics. The self-adhesive type has low shelf life as bonding properties of the membrane reduces with time.

Fig. 5.14: Bituminous Membrane Laying

Torch-on membranes have exposed and covered types. Exposed membrane often has mineral granular aggregate to withstand the wear and tear of the weathering. In the other types of membrane, the contractor needs to apply one protective screed to prevent the puncture of the membrane.

Fig. 5.15: Polyurethane Liquid Membrane

Polyurethane liquid membrane waterproofing method

Polyurethane liquid membrane method of waterproofing is used for the flat roof area and exposed to weathering. This waterproofing method is expensive.

Polyurethane liquid membrane can offer higher flexibility. Polyurethane is very sensitive to the moisture content present, therefore before application, one has to be very careful evaluating the moisture content of the concrete slab, otherwise

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peeling or de-bonding of membranes may happen after some time.

Brick Bat coba waterproofing method

Brick bat coba waterproofing method helps to seal the cracks and water leakages and hides the untidy marks. It also provides aesthetically appealing coverage using china mosaic tiles.

Fig. 5.16: Brick Bat coba waterproofing

The steps of brick bat coba waterproofing method are as follows:

1. First, the debris is removed and the whole surface is cleaned.
2. Then apply raddo of water, chemical and cement on the surface.
3. Lastly, the china mosaic tiles are put and fixed.

Poly acrylic chemical coating waterproofing

It is one of the superior levels of waterproofing solutions. First, the solution of poly acrylic chemical is prepared to seal the breakage or leakage on the wall and terrace, which gives a strong waterproof base as well as protect and preserve the strength of any structure. This is done by a highly trained professional team. You need to make sure that high-quality products are used in the procedure.

In this type of waterproofing you need to clean the place before closing the cracks with poly acrylic chemical coating. Then put two coats of poly acrylic chemical with white cement on the surface.

Fig. 5.17: Poly Acrylic chemical coating waterproofing

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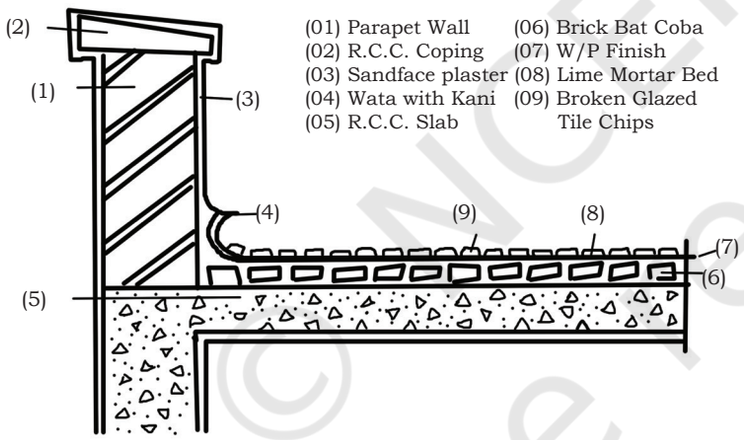
Pre-monsoon roof repairing

This method is ideal for buildings and structures that are already having leakage or damage as well as for new structures to avoid leakage in the future. This process helps in maintaining the life and quality of the building and it ensures that there is no damage to the building because of the rainfall. You can try this method once in a year in a building.

Fig. 5.18: Pre-monsoon roof repairing



(01) Parapet Wall
(02) R.C.C. Coping
(03) Sandface plaster
(04) Wata with Kani
(05) R.C.C. Slab
(06) Brick Bat Coba
(07) W/P Finish
(08) Lime Mortar Bed
(09) Broken Glazed Tile Chips

Fig. 5.19: China mosaic tile waterproofing

China Mosaic Tile Waterproofing

There are many construction materials which are not highly resistant to moisture. Therefore, a very important aspect of any construction process is to ensure the protection of materials. The modern market of construction materials is represented by various types of waterproofing materials, which are designed to effectively protect the foundation, roof, walls and floor structures from the damaging effect of groundwater moisture or precipitation.

Rigid waterproofing

It comprises waterproof dense concrete, shotcrete, metal and sand-cement plaster waterproofing, which is done by hand or by using compressed air.

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Polymeric or metal sheets are used for making stiff sheet waterproofing. They are fastened to the building envelope by the means of anchors, screws, glue, pins or by welding.

Paintable waterproofing

It is a waterproof film which is formed by coating the surface with liquid or plastic materials, such as bitumen, mastic or special paint and varnish, which have corresponding properties, i.e., resistance to moisture. Modern waterproofing paints or varnishes have synthetic resins and plastics, which also create excellent protection against moisture.

Lining waterproofing

This type of waterproofing combines two different types—paintable protection and lining waterproofing. It has greater efficiency and perfectly protects brick, concrete, metal and other surfaces. Lining Waterproofing involves coating the surface with roll or sheet material. Roofing felt is the best example of such coating. Nowadays it is also possible to use extruded polystyrene, which is glued to the bitumen mastic by hot or cold application method.

Waterproofing with wall putty

This type of waterproofing consists of different liquid compositions of mastics and mortars (mud) to create continuous seamless waterproofing layers. This is a durable waterproofing method often used in construction and trimming, as it is resistant to physical, mechanical and chemical influences. It does not crack under the influence of weather conditions or differential house settlement and it is also sufficiently elastic.

Plaster waterproofing

Plaster waterproofing can be divided into three categories on the basis of material used.

1. Cement plaster, it is applied in a layer of 5 to 40 mm to the surface.
2. Asphalt plaster, which is applied in several layers, each one of them being 4 mm thick. The

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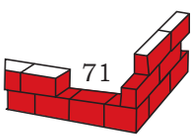

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coating represents protection made of hot or cold mastics.

3. Molded asphalt waterproofing—it is a solution of hot mastic, which is poured into the cavity between the protective wall and the insulated surface.

Fig. 5.20: Penetrating waterproofing

Penetrating waterproofing

This kind of waterproofing provides good water resistance to concrete structures. It can be applied at the beginning of the building process and at the final stage. Compositions deeply penetrate into the surface with a porous structure.

Also, this waterproofing has the properties of prevention from corrosive processes in the reinforcing structures. The penetrating protection compositions can withstand chemical attack and significantly increase resistance of the surface.

Process of Performing Various Visual Checks on Materials and Surface for Waterproofing

1. Materials used should be of standard specification and manufacturing quality.
2. Materials to be used on various surfaces should match the properties of waterproofing materials.
3. Surface has to be cleaned with water and the debris stuck on surface should be cleaned thoroughly.
4. Relevant tools are used for the application of waterproofing materials on different surfaces.

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Different Surface Preparation Method Prior to Waterproofing such as Prime Coating

A prime coat is an application of a low viscosity asphalt to a granular base in preparation for an initial layer (or surface course layer) of asphalt. The purpose of the prime coat is— to coat and bond loose material particles on the surface of the base, to harden or toughen the base surface to provide a work platform for construction equipment, to plug capillary voids in the base course surface to prevent migration of moisture, and to provide adhesion between the base course and succeeding asphalt course. After applying the prime coat, it must cure for a minimum of 48–72 hours before asphalt is placed, assuring no rain in the forecast.

At one time, prime coat was thought to be an essential the element of good pavement construction. However, in the recent years many engineers have eliminated the use of prime coat in their specifications, especially when asphalt layer(s) is 04 inches or more in thickness. Also, it is not used even when the surface thickness has been as thin as 02 inches.

Filling holes or depressions by cementitious material

One of the easiest waterproofing materials to fill the holes or depressions is called cementitious material. They are readily available from the suppliers of masonry products, also they are easy to be mixed and applied. One can get a stronger bonding and durable coating by using this material.

Hacking of existing RCC surface

Hacking means removing the surface or outer layer, whether it is of paint, cement, tile, etc.

Procedure

- The person supervising the hacking must make a detailed study of the structure to be hacked and implement a hacking plan that will ensure that the sequence of hacking does not possess risks and hazards both to the operator and the workers.

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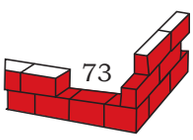

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- Explain the risks and hazards involved and the basis of safety measures to be taken to address any potential hazards or danger that may arise, and provide standing supervision to all the workers.
- Barricades should be put prior to the beginning of operations and warning sign should be displayed.
- It should be ensured that no person shall enter or work near the hacking area.
- When necessary, provide direct sufficient amount of water at breaking point to reduce dust. From protection point of view, workers must wear the basic Personal Protective Equipment (PPE), protective gloves, ear plug, dust mask and safety goggles.

Cleansing free of dust

To remove loose dust, the surface is washed with normal water. A heavy-duty, wet and dry vacuum can be used for getting water and dust off from the surface. After the floor dries, a concrete surface treatment containing magnesium fluosilicate, zinc fluosilicate or sodium silicate is applied. These preparations form a chemical bond with the cement on the surface. This treatment is usually applied in two or three coats, letting the surface dry between each application.

Priming or sealing of surface

Sealing is particularly important in concrete construction where construction joints need to be finished in a day. They occur when a structure is built of successive concrete sections. In new buildings, construction joints are sealed with suitable hydrophilic water bars, metal water stops or joint sealing strips.

For the post-construction sealing of damaged construction joints, the injection technique is used. Here, boreholes are drilled following a set pattern whereby the drilling axis should cross the joint directly in its middle. The holes are then equipped with injection

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lances through which the grouting material is injected under pressure into the joint.

During the injection process, first the injection channel is filled followed by the joint and later the cracks and gaps in the area closest to the joint. The grout then forces its way into large pores and cavities and later on during the injection process, penetrates the capillary pores. Injection process continues until counter pressure has built up in the structure, and grout discharge is evident in the area of the joint, or from the neighbouring injection lance.

Removing sharp edges

Step 1

The surface near the damaged area is cleaned by removing any loose material such as dirt, oil, or grease and unsound or flaking concrete.

Tip: Unsound or flaking concrete can be removed by using a hammer and chisel or with a masonry grinding disk and portable drill.

Step 2

The surface is scrubbed and cleaned with a stiff bristle brush to repair the area.

Step 3

After cleaning, the repairing area is rinsed thoroughly.

Following process is applied to repair concrete edges after removing sharp edges:

Step 4

Mix the quick-setting cement using a margin trowel by adding five parts of cement and one part QUIKRETE (Acrylic Fortifier) until a lump-free, putty consistency is achieved. It is important not to add more water or Acrylic Fortifier after the material has begun to set.

Tip: If the mix is too wet, adding additional Quick-Setting Cement and mixing thoroughly will help reach the desired consistency; if the mix is too dry then adding small amounts of Acrylic Fortifier works.

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Step 5

The repair area is then dampened with water to saturate the surface (standing water, if any, is removed).

Step 6

A masonry brush is used to apply a thin coating of the Quick-setting Cement and Acrylic Fortifier mixture on the surface.

Step 7

Using a margin trowel, the cement is pressed into the repair area using firm trowel pressure.

Step 8

Building and sculpting the Quick-setting Cement is continued so that the surface of the repair is above the surrounding concrete.

Step 9

Once the patch has become thumb-print hard in about 5 to 10 minutes, the edge of a margin trowel is used to mould and shape the repair to match the contour of the surrounding concrete.

Procedure for Checking Water Leakage in Waterproofed Surface

Testing of waterproofing

- Waterproofing of slabs is tested by ponding the surface with water to a depth of 25 mm for 24 hours or longer.
- The waterproofing is considered to be satisfactory, if no leaks or damp patches show on the soffit.
- IS: 2645:2003—Specification of Integral Waterproofing Compounds for cement mortar and concrete provides specifications for this waterproofing.

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Procedure for Carrying Out Horizontal and Vertical Alignment of Waterproofed Course

Surface Condition

The waterproofing membrane is kept free from sharp projections, dirt, and dust. If water testing is desired, then it is made prior to placing in protection course.

Tip: Protection course is applied at the end of each day's waterproofing to both horizontal and vertical surfaces.

Horizontal Surfaces

Protection course is installed over the waterproofing membrane as soon as possible from the membrane applicator or manufacturer. Protection course sheets are butted together and then cut to fit all the intersecting surfaces and protrusions.

Vertical Surfaces

For damp-proofed or waterproofed vertical walls to receive backfill, Protection Course are butt jointed and, if necessary, temporarily held in place while backfilling is done.

Backfilling

Backfilling against vertical walls is done immediately using care and caution to avoid damaging the waterproofing. Backfill material is not dropped against protection course in such a manner that it could drag the sheet down as the backfill drops. In horizontal applications, the waterproofing and protection course is installed just prior to the installation of the draining or wearing surface.

Precautions

An approved adhesive must be used when protection course is adhered to a waterproofing membrane. Where taped joints are desired with tape set in hot asphalt, consult a membrane manufacturer. Protection course is shipped on pallets with the polyethylene anti-stick sheet on the top or exposed

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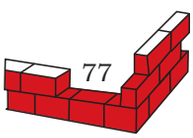

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side, and it is stored on pallets and placed on a level surface.

Procedure for Transferring Levels on Floor for Maintaining the Desired Slope

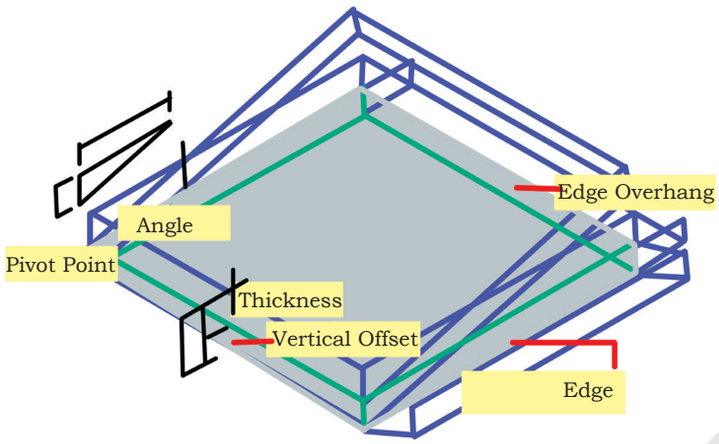

Fig. 5.21: Maintaining desired slope

First transfer the lines from temporary bench using strings or water level to column or plinth level. Mark the signage of bench on each corner of the room or building.

According to defined gradient suggested in the drawing, we can easily maintain the slopes on floors for various purposes like drain, etc.

Procedure for Carrying Out Brick Bat Coba Waterproofing

Waterproofing by brick bat coba

In brick bat coba, roof slabs constructed either by RC or RCC, need insulation for thermal comfort and waterproofing treatment to prevent leakage of water. Both these requirements are effectively fulfilled by brick bat coba treatment, the details of which are given below: The existing treatment and coating is removed and the surface is cleaned by hard wire brush and also washed with water. The surface is made free from any oil, grease, dust and such material. Expansion joints are treated on the basis of standard practice.

All non-structural cracks more than 0.5 mm wide and construction joints, if any, are cut in 'V' shape, cleaned with wire brush and washed, and then the cracks are filled by polymer modified cement or mortar using acrylic polymer, with the additional cement slurry mix spread upon cleaned SSD roof surface. Over this 15 mm thick cement, sand mortar that is mixed in the ratio of 1:4 is laid with water proofer.

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Brick bat laying

A layer of brick bats, which have been soaked overnight in water, is laid on the green mortar, having an average thickness of about 110 mm, about 70 mm near rainwater pipe and 150 mm at ridge. The gaps between the brick bats are generally kept between 15 and 20 mm; these gaps are filled with cement sand mortar in the ratio of 1:4 with water-proofer. In hot and dry weather, the surface is covered with wet gunny bags immediately after finishing. Curing starts the next day and continued for seven days.

Finishing layer

The top surface is then given a smooth finish with 20 mm thick cement sand mortar in the ratio of 1:4, admixed with a water-proofer. All liquid admixtures are mixed with the mixing water. The surface when green is marked with 300 mm false squares. Curing is to be done by ponding.

Methods and Techniques to Protect Waterproofing as per the Site Requirements

(a) If the roofs are made for home or for any machinery purposes, it requires periodic maintenance or cleaning, it is recommended to produce walkways using concrete pavements laid on supports, or a concrete screed, to give all the operators a safe access route to follow. Before installing walkways, a suitable separating layer must be placed between the membrane and the in-situ concrete deck.

(b) Special footwear is worn when walking directly on the waterproofing membrane, both for the safety of the person and to avoid damaging the membrane.

(c) If it is needed to walk on the waterproofing membranes, the hottest part of the day in summer is avoided and similarly, the coldest part of the day in winter. To avoid putting membranes under particularly high mechanical stress, footwear with very thick soles (cleated sole footwear) is used, instead

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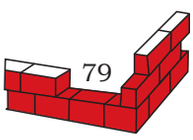

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of the use of footwear with smooth soles is recommended. Prior to using cleated sole footwear, a check is done that no fine gravel or other abrasive material has accidentally stuck to or become lodged in the sole before walking on the waterproofing membrane to avoid the risk of scraping or piercing the membrane in question.

(d) Extreme care is taken to avoid the risk of slipping when accessing a roof during rain or if the roof has pooling water or is icy.

(e) Utmost care is taken to never place anything heavy or sharp directly on the waterproofing membrane, unless a suitable protective surface has been prepared first to set the object down on and distribute the load (such as wooden planks or other suitable devices).

Application of waterproofing

Waterproofing is done in various parts of the building which includes:

1. Water Closet (W.C.)
2. Bathrooms
3. Terrace
4. Roofs and *Chajjas*
5. Basement, swimming pools and underground ducts
6. Underground and overhead water tanks
7. R.C.C. Roof slab

Water Closet (W.C.) waterproofing

(A) Following pre-work is completed before beginning the waterproofing work

1. Plastering of the internal wall is completed leaving a margin of 18" from the final floor level of W.C. unit.
2. Grooving work for concealed G.I. piping or electrical conduit piping in W.C. is completed.
3. The work of making holes for connecting *nahani* trap, P-trap, floor trap, etc., to external drainage line in the external wall is completed.

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4. All the debris is removed from the floor of W.C.
5. W.C. is cleaned thoroughly with water.
6. Marking is done on the walls for setting up of trap level.
7. Sufficient amount of water is used for cleaning of W.C.

(B) Base Coat for W.C. waterproofing

1. A thick cement mortar base coat with 25 mm to 40 mm thickness in proportion of 1:4 is provided in W.C.
2. The above mentioned coat is provided with a slope of 1:100 from entrance door towards the water escape pipe.
3. Similarly, this basecoat is provided on all the walls up to 45 cm height above toilet finished floor level.
4. Water is filled up to the height of base for minimum four days. The purpose of filling water is for curing and testing of waterproofing.
5. It is checked and tested after four days.

(C) Topping Coat for W.C. waterproofing

- The coating of brick bat coat is done with 1:4 cement mortar mixed with waterproofing material. With the help of metal float, finishing is done with cement slurry.
- For better bonding, surface of the side wall is roughened with wire brush up to 45 cm above W.C. floor level. As the thickness of this material is very thin, it will not affect anything.
- After the final coat, water is filled up to 7.5 cm depth in the water closet for minimum seven days for better curing.

Components of Topping Coat for W.C. Waterproofing

1. Firstcoat W/P (*tipani*)
2. Water escape pipe

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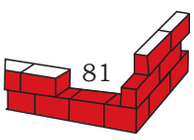

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Polyflex WP is a flexible waterproof brush or roller applied on cementitious coating seepage of water, salts and pollutants, whilst still allowing the substrate to breathe.

3. Wire mesh and filter media
4. 'P' trap
5. Brick bat coba coat
6. Final coat W/P (Topping coat)
7. W/C pan
8. Filling material
9. Top finishing by mortar
10. Mortar bed
11. Glazed tile flooring

Bathroom waterproofing

(A) Preparation of bathroom waterproofing

- After completing the plastering work of internal wall, a margin of 18" from the final floor level of the bathroom is kept.
- The grooving work for concealed G.I. and electrical conduit piping in the bathroom is completed.
- The holes for connecting *nahani* trap, P-trap, floor trap, etc., to the external drainage line in external wall are made.
- All the debris from the floor of the bathroom is removed.
- The bathroom is cleaned thoroughly with water.
- The level is marked in red on the walls for setting up of the trap level.

Nahani trap is provided in the floor to collect waste water from washbasin, shower, sink and bathroom, etc. These are available in cast iron or UPVC material and have removable grafting (*jali*) on the top of the trap.

(B) Base coat for bathroom waterproofing

1. Provide cement mortar base coat of 15 mm to 25 mm thickness in proportion of 1:4 in the bathroom. This coat is prepared with a slope of 1:100 from entrance door to water escape pipe.
2. The base coat will cover all the walls up to the outer face wall line at the entrance door and the bottom portion of the *nahani* trap connection hole made in the wall.

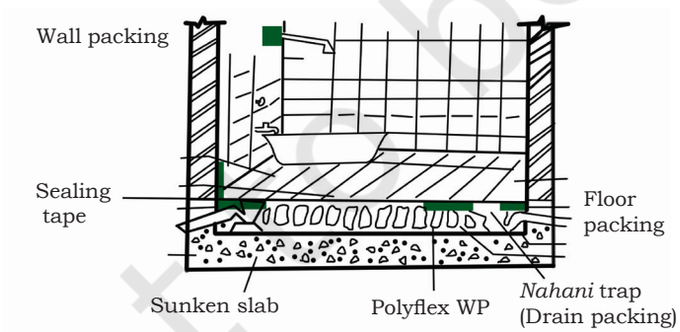

Fig. 5.22: Base coat for bathroom waterproofing

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3. Water is filled up to the height of base for minimum four days. The purpose of filling water is for curing and testing of waterproofing quality.
4. Fix the *nahani* trap and water escape pipe or leakage drain pip over the base coat. Also all the concealed pipes such as G.I. outlet pipe for wash basin, etc., are laid.

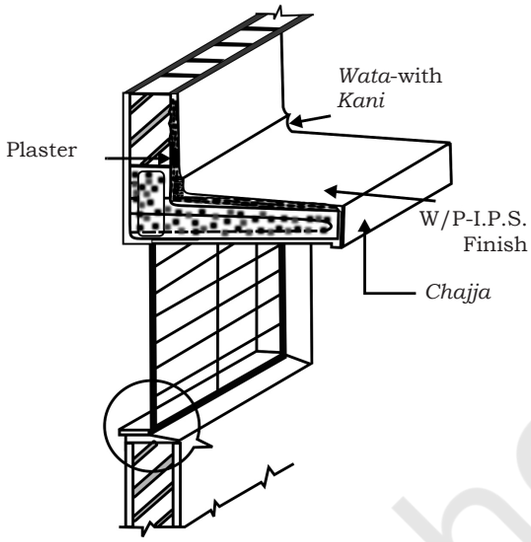

Fig. 5.23: Terrace and chhajja waterproofing

Terrace waterproofing

It is a tricky problem in building construction, mainly because the surfaces are flat. This means that water cannot run off the structure quickly, and will move slowly or pool above the surface, creating opportunities for leakage.

Terrace waterproofing is able to resist leakage during heavy rainfall. It also provides insulation against heat loss during summers and winters and avoids humidity.

In addition, these flat surfaces require sumps or collection pits for water to flow into before entering the vertical drainage pipes, which could be a source of leaks.

The best way to waterproof a flat terrace is to use a waterproofing coating. This is a thin layer of waterproof material that is continuous, and offers no path for water to enter the structure. The membrane is laid on top of the structural slab. On top of the membrane, a filler material is laid. The filler material is necessary to give a slope to the finish of the terrace. This slope runs towards the drainage outlets.

Roof and Chajjas (awnings) waterproofing method

1. Wash the roof surface making it dust free.
2. Fill all the visible cracks by way of specially prepared silicone crack filler.
3. Apply the first coat for filling the invisible cracks and small holes with diluted silicone.
4. Apply the second and third coat of silicone based cement waterproofing to strengthen the surface.

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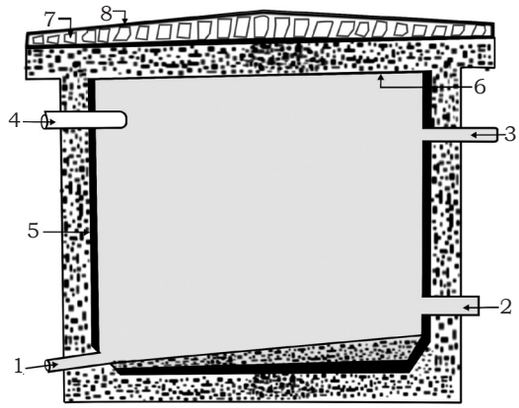

1. Washout Pipe
2. Outlet Pipe
3. Overflow Pipe
4. Inlet Pipe
5. Smooth Cement Finish with W/P compound
6. No W/P treatment
7. Brick Bat Coba
8. W/P I.P.S. Finish

Fig. 5.24: Overhead tank waterproofing

5. Apply the fourth (final) coat of silicone based cement waterproofing.

Clean the top of the *chajja* and chisel extra mortar, if any.

- Apply thick cement slurry over the top of the *chajja*.
- Apply 1:1.5:3 screen coat.
- Make rounding at the junction of *chajja* and wall of the building.
- Cure this coat for seven days.
- Apply a finishing coat with C.M. 1:4 with a waterproofing compound.
- Cure the waterproofing for atleast seven days.

The final layer is the finish layer. This may be a tile, or a stone, or any material that can withstand outdoor conditions. The finish and the filler layers themselves do not contribute to waterproofing.

Basement, swimming pools and underground ducts

For basement, swimming pools and underground ducts such as lift pits, the waterproofing has to withstand the water pressure in addition to its basic stress.

Work procedure

- Carry out the work of PCC bed and provide a cement mix 1:4 base coat with waterproofing compound, and above this fix rough Shahabad tiles.
- Maintain the break joint pattern while fixing the tile for base.
- After fixing the tiles, grout the joints with cement slurry completely.
- Apply a jointless layer of cement mortar 1:3 25mm thick and cure it for seven days.

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- For basement, provision of gutter and sump is made in PCC itself and Shahabad base is also prepared in the same way. The gutter is given proper slope towards the sump. This is done as a preventive measure against occasional entry of rain water into the basement.
- After curing, provide the final jointless waterproof plaster coat in cement mortar 1:4 over the rough shahabad tiles.

Overhead tank waterproofing

Chisel the extra concrete in the tank, particularly in the corners around the chambers. Clean the entire tank, along with the bottom slab and side walls and throw away the debris. Allow the cement slurry to penetrate all the holes and cracks of the bottom slab. Check the hacking of vertical walls from inside for better bonding with waterproofing.

Waterproofing of R.C.C. roof slab

The given steps are followed for waterproofing of the sloping terrace or *chajja*:

1. First, the surface of the sloping terrace or *chajja* is cleaned.
2. After that thick cement slurry is applied over the surface of the slab and then 1: 1½: 3 metal screen coat is applied.
3. This coat is protected for at least seven days by putting wet gunny bags on it.
4. Over this coat, a finishing coat with cement sand mortar in the ratio of 1:4 and waterproofing compound is applied as per the design.
5. Finally, the cement slurry with the waterproofing compound is applied and then colour pigments such as red, green, etc., are added.

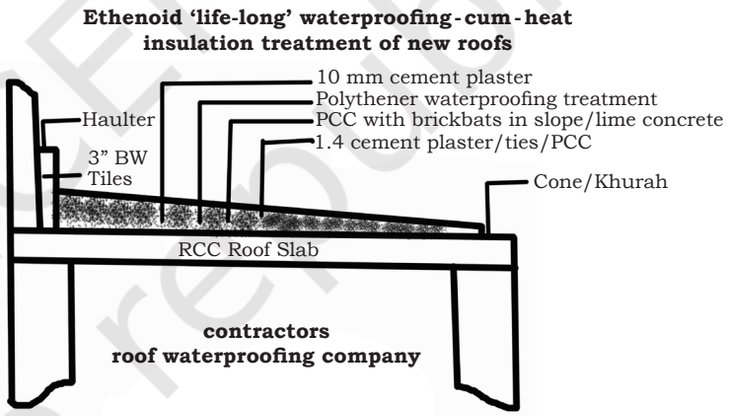

Fig. 5.25: Waterproofing of R.C.C. Roof Slab

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6. On the second day, an edge is made between the parapet wall and sloping slab.
7. This waterproofing is cured for fifteen days with wet gunny bags spread over it.

Check Your Progress

A. Answer the following

1. What is meant by waterproofing?
2. What are the different types of waterproofing?
3. Give the cement mortar mix proportions used for waterproofing works.
4. Enlist the surface preparation methods prior to waterproofing works.
5. How cementitious waterproofing course is laid?
6. Explain the method of brick bat coba waterproofing for RCC terrace roof.
7. Name any three types of waterproofing compounds used in waterproofing works.

B. Fill in the blanks

1. Wonder-seal is an integral _____ compound for plaster and concrete.
2. Brick bat waterproofing helps seal the _____ and _____ leakages.
3. Cementitious materials are probably the _____ waterproofing materials to fill the holes or depressions.
4. All existing treatment, coatings on roof slab top is to be removed and surface cleaned by a _____ and washed with water.
5. Bituminous membrane waterproofing method is used for _____ sloped roofs due to their proven performance.

C. Multiple choice questions

1. After stopping the leakage of the base slab, provide _____mm to _____mm thick cement mortar base coat in proportion of (1:4).
   (a) 25 to 40 (b) 25 to 50
   (c) 30 to 40 (d) 40 to 25
2. Tools required for waterproofing work are_____.
   (a) Trowel (b) Wooden float
   (c) Plumb bob (d) All of these
3. Bituminous membrane waterproofing is a popular method used for _____roofs.
   (a) low-sloped (b) high-sloped
   (c) medium-sloped (d) None of these

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4. Chemical attack can occur because concrete is_____.
   (a) alkaline (b) acidic
   (c) hydrant (d) less reactive
5. Concrete is very strong in compression but relatively weak in_____.
   (a) elasticity (b) tension
   (c) flexibility (d) None of these

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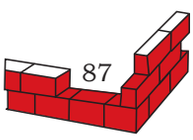

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Answer Key

Unit 1: Stone Masonry

B. Fill in the blanks

1. mortar
2. dowels
3. common, ordinary
4. irregular
5. construction
6. two

C. Multiple choice questions

1. c
2. d
3. a
4. c
5. c

Unit 2: Brick Masonry

B. Fill in the blanks

1. course
2. Header
3. moulding
4. lifting and spreading
5. verticality
6. bricks
7. alignment, wall
8. Header

C. Multiple choice questions

1. a
2. b
3. b
4. a
5. b

Unit 3: Plastering Work

B. Fill in the blanks

1. plaster
2. sand
3. 10 mm
4. peeling
5. brush

C. Multiple choice questions

1. a
2. a
3. b
4. a
5. b

Unit 4: Precast Block Masonry

B. Fill in the blanks

1. Precast concrete block
2. 1:3
3. Solid
4. 14
5. Field test, Laboratory test

C. Multiple choice questions

1. a
2. d
3. c
4. b
5. c

Unit 5: Waterproofing Works for Structures using Cementitious Materials

B. Fill in the blanks

1. waterproofing
2. cracks, water
3. easiest available
4. hard wire brush
5. low

C. Multiple choice questions

1. a
2. d
3. a
4. a
5. b

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Glossary

Abutment: *a structure built to support the lateral pressure of an arch or span, e.g. at the ends of a bridge.*

Abutment: *a structure built to support the lateral pressure of an arch or span.*

Ashlar: *masonry made of large square-cut stones, used as a facing on walls of brick or stone rubble.*

Break water: *refers to a wall built out into the sea to protect the shore or harbour from the force of waves.*

Brick bat: *refers to the broken pieces of bricks.*

Brick bats: *is defined as the cut portion of a brick*

Bridge piers: *refers to structures used for supporting a bridge, embedded into the ground surface or into water under the bridge.*

Ballast: *is a material that is used to provide stability to a structure.*

Bed: *is the mortar upon which a brick is laid.*

Cleated: *a strip of wood or iron used to strengthen or support the surface to which it is attached.*

Deliquescent: *is the process by which a substance absorbs moisture from the atmosphere until it dissolves in the absorbed water and forms a solution*

Gneiss: *is a metamorphic rock with a banded or foliated structure, typically coarse-grained and consisting mainly of feldspar, quartz, and mica.*

Kiln dust (CKD): *is a fine, powdery material, portions of which contain some reactive calcium oxide, depending on the location within the dust collection system, the type of operation, the dust collection facility, and the type of fuel used. Kiln dust may be produced from cement or lime industry also.*

Lances: *a piece of glass or other transparent material with curved sides for concentrating or dispensing light rays.*

Mortises: *a rectangular hole in a piece of wood, stone, etc. into which another piece is fixed.*

Plinth: *base course of a building*

Pier: *is a solid support designed to sustain vertical pressure.*

Ponding: *refers to the act of pooling of unwanted water on a flat roof or road.*

Pumice: *is a very light weight, porous and abrasive material and it has been used for centuries in the construction and beauty industry as well as in early medicine.*

Sandstone: *is a stone that is formed of grains of sand tightly pressed together, used in building construction.*

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Screeds: *A strip of wood, plaster, or metal placed on a wall or pavement as a guide for the even application of plaster or concrete.*

Spalling: *is the result of water entering brick, concrete, or natural stone.*

Sump: *is a pit or low space that often collects undesirable liquids such as water or chemicals.*

Trowel: *is a small tool with a flat blade used in building construction for spreading cement or plaster.*

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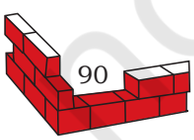

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